I claim:

1. A method of generating high purity phosphine gas, comprising producing phosphine gas by the interaction of microwave radiation with a precursor material while said precursor material passes through a microwave transparent, metal free, gas impermeable, pressurized reaction zone.

2. The method of Claim 1 wherein the precursor material is H_3PO_2 in an aqueous solution.

3. The method of Claim 1 wherein the precursor material is H_3PO_3 in an aqueous solution .

4. The method of Claim 1 wherein the precursor material is crystalline H_3PO_2 or crystalline H_3PO_3.

5. The method of Claim 1 wherein the precursor material is a salt of the formula XH_2PO_2 in an aqueous solution where X is selected from the alkali metals group consisting of Li, Na, and K.

6. The method of Claim 1 wherein the precursor material is a salt of the formula $X_2(H_2PO_2)_2$ in an aqueous solution where X is selected from the alkaline metals group consisting of Ca, Mg, Sr, and Ba.

7. The method of Claim 1 wherein the precursor material is a salt of the formula XH_2PO_3 in an aqueous solution where X is selected from the alkali metals group consisting of Li, Na, and K.

8. The method of Claim 1 wherein the precursor material is a slurry of red phosphorus in an alkaline solution.

9. The method of Claim 8 wherein the alkaline solution is selected from the group consisting of NaOH, KOH, and LiOH dissolved in water or combinations thereof.

10. The method of Claim 1 wherein the high purity gas contains no more than 100 parts per million of oxygen or water vapor.

11. A chemical reactor system for generation of high purity gas, comprised of a source of microwave radiation, a microwave transparent, gas tight barrier, a microwave reflecting enclosure into which said source of microwave radiation is directed, a manifold for gas delivery adapted to receive generated gas from said enclosure, a solvent vapor removal device adapted to remove solvent vapor from the generated gas, a gas concentration sensor for sensing gas concentration in the generated gas, and a feed-back control system to control gas generation rate in said enclosure.

12. The system of Claim 11, wherein the microwave radiation source has a frequency of 0.9 GHz, or 2.41 to 10 GHz.

13. The system of Claim 11, wherein the microwave transparent barrier is constructed from materials chosen from the group Teflon, fused silica, silicon dioxide, boron nitride, or graphite.

14. The system of Claim 11, wherein the microwave reflecting enclosure is constructed from an electrically conductive material with a conductivity of a least 10^{-3} ohm/cm.

15. The system of Claim 11, wherein the microwave reflecting enclosure has a smallest dimension of at least twice the wavelength of the microwave radiation.

16. The system of Claim 11 wherein the precursor material is selected from the group consisting of hypophosphorous acid, hypophoric acid, and an alkaline slurry of red phosphorous.

17. The system of Claim 11 wherein the vapor removal device contains silica gel.

18. The system of Claim 11, wherein the feedback control system includes a microprocessor controlled temperature feedback loop to a raw material feed pump, and microwave radiation source power supply.

19. The system of Claim 11 wherein the feedback control system modulates the electrical power to the microwave radiation source to maintain a constant gas delivery pressure.

20. The system of Claim 11 wherein the feedback control system modulates the electrical power to the microwave radiation source to provide a variable gas flow rate.

21. The system of Claim 11 wherein the feedback control system modulates the microwave radiation frequency to control the reaction product selectivity.

22. A concentration control system for phosphine product gas, comprising:

a concentration monitor for measuring the ratio of phosphine to diluting gas in a product gas stream;

a microprocessor based comparitor to determine the present concentration versus a desired concentration of phosphine gas in the product gas stream; and

a gas flow controller to control the introduction of a diluting gas into the product gas stream in response to a signal generated based on said determination.

23. The system of claim 22, wherein the phosphine gas is generated by reaction of a precursor material under the influence of microwave radiation.

24. A method for generating a high purity gas for semiconductor processing, comprising producing the gas by the interaction of microwave radiation with a precursor material while

said precursor material passes through a microwave transparent, metal free, gas impermeable, pressurized reaction zone.

25. A method for fabricating a semiconductor device using a gas, characterized by the use of the gas when produced by the reaction of a precursor material under the influence of microwave radiation.

26. The method of claim 25, which comprises:

producing the gas continuously by a continuous introduction and reaction of the precursor material in a microwave transparent reaction chamber irradiated with microwave radiation; and

feeding the produced gas continuously as it is formed to a semiconductor fabrication process.

27. The method of claim 26, wherein the gas is continuously fed as it is produced to a chemical vapor deposition reactor or an oxidation furnace.

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~~28. The method of any of claims 24-27, wherein the precursor material is liquid, and wherein the reaction produces a two-phase system including the gas.~~

~~29. The method of any of claims 24-28, wherein the gas is phosphine.~~

30. An apparatus for the fabrication of a semiconductor device, comprising:

a gas generation reactor for generating a gas, the gas generation reactor having a microwave transparent reaction chamber and a source of microwave radiation directed into the reaction chamber; and

a chemical vapor deposition reactor or an oxidation furnace coupled to the gas generation reactor.

31. The apparatus of claim 30, wherein the gas is phosphine.

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